**What is claimed:**

1. A direct write process for fabricating a desired circuit component onto a substrate surface of a microelectronic device according to a computer-aided design (CAD), said process comprising:

(a) providing a support member by which said device substrate is supported while said component is being fabricated;

(b) providing a chamber for containing a precursor fluid material under a substantially constant pressure differential relative to the ambient pressure, said precursor fluid material having a viscosity no less than 10 cps;

(c) operating an inkjet-based single-orifice or multiple-orifice dispensing head for dispensing and depositing minute droplets of said precursor fluid material through at least one discharge orifice onto said substrate surface, said dispensing head having valve means in control relation to said dispensing head for switching said head on and off on demand;

(d) operating a material treatment means to convert said deposited precursor material to said desired component; and

(e) operating machine control means for generating control signals in response to coordinates of said CAD and for controlling the position of said dispensing head relative to said support member or said substrate in response to said control signals to control dispensing and depositing of said precursor material to form said component of a desired shape and dimension on said substrate surface.

2. The process of claim **1** wherein said substantially constant pressure differential is variable and is varied by a method comprising:

operating a pump means to deliver said precursor fluid material from a reservoir to said chamber, wherein said valve means, when switched on, allows said fluid material to be dispensed through said dispensing head and, when switched off, allows at least a portion of said fluid material to flow back to said reservoir through a flow channel; and

operating a flow-regulating means to adjust a fluid material back-flow rate through said flow channel for maintaining a desired fluid material pressure inside said chamber.

3. The process of claim **2** wherein said pump means comprises a device selected from the group consisting of a gear pump, an extruder, a piston, a positive displacement pump, an air pump, a motor-driven linear motion device, an actuator, or combinations thereof.

4. The process of claim **2** wherein said flow-regulating means comprises a needle-like valve to adjust an effective cross-section of said flow channel through which said at least a portion of fluid material flows back to said chamber.

5. The process of claim **2** wherein said flow-regulating means comprises a spring.

6. The process of claim **4** wherein the position of said needle-like valve is adjustable and is adjusted by using an actuator means prior to or in real time during step (c).

7. The process of claim **1** or **2**, wherein said material treatment means is selected from the group consisting of a ventilation fan, a vacuum pump, an air blower, a cooling device, a heater, an ultraviolet light source, an infrared source, a laser beam, an electron beam, an X-ray source, a Gamma-ray source, an ion beam source, a microwave source, an induction generator, and combinations thereof.

8. The process of claim **1** or **2**, wherein said valve means comprises a pneumatically operated valve or a solenoid valve.

9. The process of claim **1** or **2**, wherein said pressure differential exceeds one pound per square inch (psi) and its actual value is predetermined in accordance with the precursor fluid viscosity.

10. The process of claim **1** or **2**, wherein said motion control means include servo means for indexing and positioning said dispensing head relative to said support member in at least two dimensions.

11. The process of claim **10**, wherein said servo means provide indexing and positioning in a third dimension.

12. The process of claim **1** wherein said constant pressure differential is variable with the variations being achieved by using a compressed air source, a back-flow channel and a pressure-regulating needle valve.

13. The process of claim **1**, **2**, or **12**, wherein said precursor fluid material comprises a volatile liquid ingredient selected from the group consisting of water, ethanol, methanol, acetone, and mixtures thereof.

14. The process of claim **1**, **2**, or **12**, wherein said precursor fluid material comprises an ingredient selected from the group consisting of a polymeric, organic, organo-metallic, ceramic, glass, carbonaceous, metallic material, and combinations thereof.

15. The process of claim **1**, **2**, or **12**, wherein said precursor fluid material is in a form or physical state selected from the group consisting of a melt, a solution, a suspension, a sol-gel, or a colloidal fluid.

16. The process of claim **1**, **2**, or **12**, wherein said circuit component comprises a material selected from one of the following groups of materials:

(A) Metals, including silver, nickel, gold, copper, chromium, titanium, aluminum, platinum, palladium, and alloys thereof;

(B) Ceramics, including alumina ($Al_2O_3$), silica, glasses, and mixtures thereof;

(C) Dielectrics, including alumina, magnesium oxide (MgO), yttrium oxide ($Y_2O_3$), zirconium oxide ($ZrO_2$), and cerium oxide ($CeO_2$);

(D) Ferroelectrics, including barium titanate ($BaTiO_3$), strontium titanate ($SrTiO_3$), lead titanate ($PbTiO_3$), lead zirconate ($PbZrO_3$), potassium niobate ($KNbO_3$), strontium bismuth tantalate ($SrBi_2Ta_2O_9$), $(Ba,Sr)TiO_3$, and solid solution stoichiometric variations thereof;

(E) Piezoelectrics, including quartz, AlN, and lead zirconate titanate;

(F) Ferrites, including yttrium iron garnet ($Y_3 Fe_5O_{12}$), barium zinc ferrite ($Ba_2Zn_2Fe_{12}O_{19}$), hexagonal ferrites, barium ferrite, spinel ferrites, nickel zinc ferrites, manganese zinc ferrite, and magnetite ($Fe_3O_4$);

(G) Electro-optical ceramics, including lithium niobate ($LiNbO_3$), lithium tantalate ($LiTaO_3$), cadmiun telluride (CdTe), and zinc sulfide (ZnS);

(H) Ceramic superconductors, including $YBa_2Cu_3O_{7-x}$ (YBCO), $Tl_2CaBa_2Cu_3O_{12}$, $La_{1.4}Sr_{0.6}CuO_3$, BiSrCACuO, BaKBiO, and halide doped fullerines;

(I) Chalcogenides, including SrS, ZnS, CaS, and PbS;

(J) Semiconductors, including Si, Ge, GaAs, and CdTe;

(K) Phosphors, including SrS:Eu, SrS:Ce, ZnS:Ag, $Y_2O_2$:Eu, and $Zn_2SiO_4$:Mn;

(L) Transparent conductive oxides, including indium tin oxide, zinc oxide, tin oxide, indium oxide, and mixture thereof; and

(M) Bio- and chemical sensing elements.

17. The process of claim **1**, **2**, or **12**, wherein said precursor fluid has a viscosity no less than 20 cps.

18. The process of claim **1**, **2**, or **12**, wherein said valve means of said inkjet-based dispensing head comprises a mechanism selected from the group consisting of a piezo-electric element, a thermal actuation element, and a solenoid valve.

19. A direct write process for fabricating at least one desired circuit component onto a substrate surface of a microelectronic device according to a computer-aided design (CAD), said process comprising:

(a) providing a supply of a first precursor fluid material, with a viscosity no less than 10 cps, under a substantially constant but variable pressure differential relative to ambient pressure;

(b) dispensing said first precursor fluid material from at least an inkjet-based dispensing head onto said substrate surface of said device supported by a support member;

(c) during said dispensing step, moving said dispensing head and said support member or said substrate relative to one another in a plane defined by first and second directions to form said first precursor material into a desired pattern according to said design; and

(d) concurrent with or subsequent to said dispensing and moving steps, operate a material treatment means to convert said first deposited pattern of precursor material into at least a portion of said at least one desired circuit component.

20. The process of claim **19**, wherein said substantially constant but variable pressure differential is varied by a method comprising:

operating a pump means to deliver said precursor fluid material from a reservoir to said chamber, wherein said valve means, when switched on, allows said fluid material to be dispensed through said dispensing head and, when switched off, allows at least a portion of said fluid material to flow back to said reservoir through a flow channel; and

operating a flow-regulating means to adjust a fluid material back-flow rate through said flow channel for maintaining a desired fluid material pressure inside said chamber.

21. The direct write process of claim **19** or **20**, further comprising repeating steps (a) through (d) to dispense and deposit a second precursor fluid material of a second desired pattern onto said substrate surface and converting said second deposited precursor fluid material onto at least a second portion of said at least one component or a second component of said device.

22. The direct write process of claim **19** or **20**, further comprising repeating steps (a) through (d) to deposit multiple components onto said substrate surface to form a first layer of said device.

23. The direct write process of claim **22**, further including the steps of forming multiple layers of components on top of one another by repeated dispensing and converting of said precursor fluid materials as said dispensing head and said support member are moved relative to one another in one direction parallel to said plane, with said dispensing head and said support member being moved away from one another in said third direction by a predetermined layer thickness after each preceding layer has been formed.

24. The direct write process of claim **19** or **20**, further including the steps of:

creating a geometry representation of said device on a computer, said geometry representation including a plurality of segments or data points defining said device;

generating programmed signals corresponding to each of said segments or data points in a predetermined sequence; and

moving said dispensing head and said support member relative to one another in response to said programmed signals.

25. The direct write process of claim **19** or **20**, wherein said moving step includes the step of moving said dispensing head and said support member relative to one another in a direction parallel to said plane according to a first predetermined pattern to dispense said precursor fluid material at a rate for forming an outer boundary of a component on said device substrate surface, said outer boundary defining an exterior surface of said component.

26. The direct write process of claim **25**, wherein said outer boundary defines an interior space in said component and wherein a fluid material pressure is increased to a higher pressure level, and said moving step further includes the step of moving said dispensing head and said support member relative to one another in said direction parallel to said plane according to at least one other predetermined pattern to fill said interior space with said material at a higher rate.

27. The direct write process of claim **26**, further comprising the steps of creating a geometry representation of said device on a computer, said geometry representation including a plurality of segments or data points defining said object, and generating programmed signals corresponding to each of said segments or data points in a predetermined sequence, wherein said programmed signals determine said movement of said dispensing head and said support member relative to one another in said first predetermined pattern and said at least one other predetermined pattern.

28. The direct write process of claim **1**, **2**, **19**, or **20**, wherein said substrate is selected from the group of flexible materials consisting of a plastic, elastomer, fabric, paper, composite, and

combinations or mixtures thereof.

29. The direct write process of claim **28**, wherein said substrate is prepared in a roll form.

30. The direct write process of claim **28**, further comprising continuously or intermittently moving said substrate from a roll of substrate supply disposed at one side of said support member into a fabrication zone above said support member and then out of said fabrication zone upon deposition of said component.

31. The direct write process of claim **30**, further comprising a step of collecting said substrate at another side of said support member to complete a roll-to-roll fabrication process.

32. A direct write apparatus for fabricating a desired circuit component onto a substrate surface of a microelectronic device according to a computer-aided design (CAD), said apparatus comprising:

(a) a support member for supporting thereon said device substrate;

(b) a fluid material delivery assembly comprising a chamber at a distance from said support member for containing a precursor fluid material under a substantially constant but adjustable pressure differential relative to the ambient pressure;

(c) an inkjet-based dispensing head in flow communication with said chamber, said head comprising on one end at least a discharge orifice of a predetermined size and a valve means in control relation to said at least a discharge orifice for dispensing droplets of said precursor fluid material through said orifice onto said substrate surface; and

(d) machine control means in electronic communication with a computer and in control relation to both said support member and said dispensing head for generating control signals in response to coordinates of said design of the device and for controlling the position of said dispensing head relative to said support member in response to said control signals to control dispensing of said precursor material for fabricating said component.

33. The apparatus of claim **32**, wherein said fluid material delivery assembly further comprises:

a fluid material reservoir containing therein a desired amount of said precursor fluid material,

a pump means to deliver said precursor fluid material from said reservoir to said chamber;

a back flow channel having a first end in flow communication with said chamber and a second end in flow communication with said reservoir; and

a flow-regulating means in control relation to said channel to adjust the material back-flow rate through said channel for maintaining a desired fluid material pressure inside said chamber.

34. The apparatus of claim **33**, wherein said pump means comprises a gear pump.

35. The apparatus of claim **33**, wherein said flow-regulating means comprises a needle-like valve positioned between said first end and said second end of said back flow channel to adjust an effective cross-section area of said back-flow channel through which said fluid material can back flow to said reservoir.

36. The apparatus of claim **33**, wherein said flow-regulating means comprises a spring.

37. The apparatus of claim **35**, further comprising an actuator means in control relation to said needle-like valve for adjusting the position of said needle-like valve relative to said back flow channel.

38. The apparatus of claim **32**, wherein said fluid material delivery assembly further comprises:

a material reservoir providing said fluid material to said chamber,

a compressed air source exerting a pressure to said reservoir;

a back flow channel having a first end in flow communication with said chamber and a second end in flow communication with said reservoir; and

a flow-regulating means in control relation to said channel to adjust the material back-flow

rate through said channel for maintaining a desired fluid material pressure inside said chamber..

39. The apparatus of claim **32, 33**, or **38**, further comprising a substrate feeder disposed at one side of and at a distance from said support member for feeding said substrate onto said support member.

40. The apparatus of claim **39**, further comprising a substrate collector disposed at another side of and at a distance from said support member for collecting said substrate therefrom upon deposition of said component.

41. The apparatus of claim **39**, wherein said feeder comprises a roller.

42. The apparatus of claim **40**, wherein said collector comprises a roller.

43. An inkjet printhead-based fluid dispensing apparatus, comprising:

(A) a fluid material reservoir;

(B) an inkjet printhead body comprising therein a chamber having a first end in flow communication with said reservoir and receiving a fluid material therefrom and on a second end a discharge orifice for discharging a fluid material therethrough;

(C) a valve means in control relation to said discharge orifice; and

(D) a back-flow channel having one end in flow communication with said chamber and another end in flow communication with said reservoir.

44. The inkjet printhead-based fluid dispensing apparatus of claim **43**, wherein said printhead body comprises a solenoid valve body and said valve means comprises an electromagnetic valve.

45. The inkjet printhead-based fluid dispensing apparatus of claim **43**, wherein said valve means comprises either a piezo-electric actuator or a thermal actuation element.

46. The inkjet printhead-based fluid dispensing apparatus of claim **43**, wherein said back-flow channel is controlled by a flow-rate regulator means.

47. The inkjet printhead-based fluid dispensing apparatus of claim **46**, wherein said flow-rate regulator means comprises a needle valve.